

FIG. 1

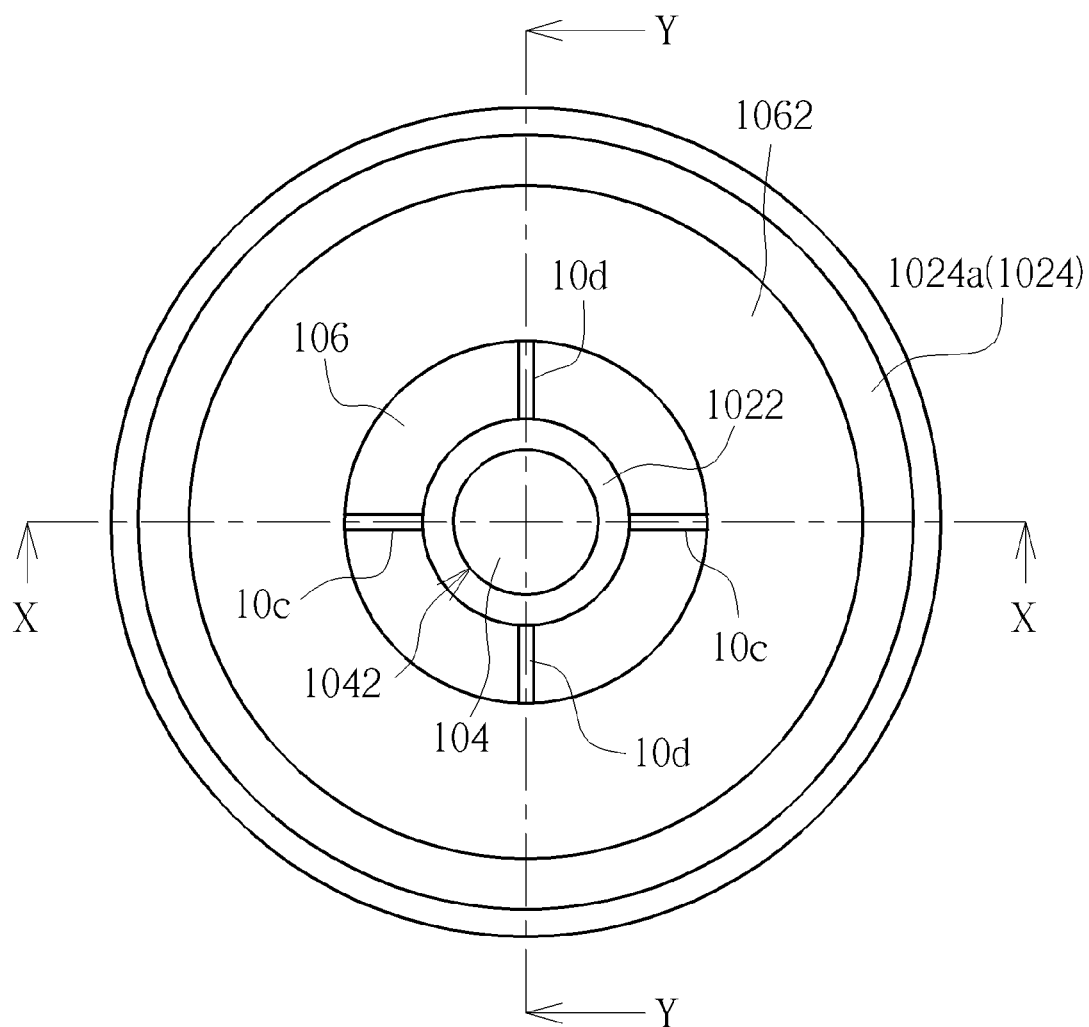


FIG. 2

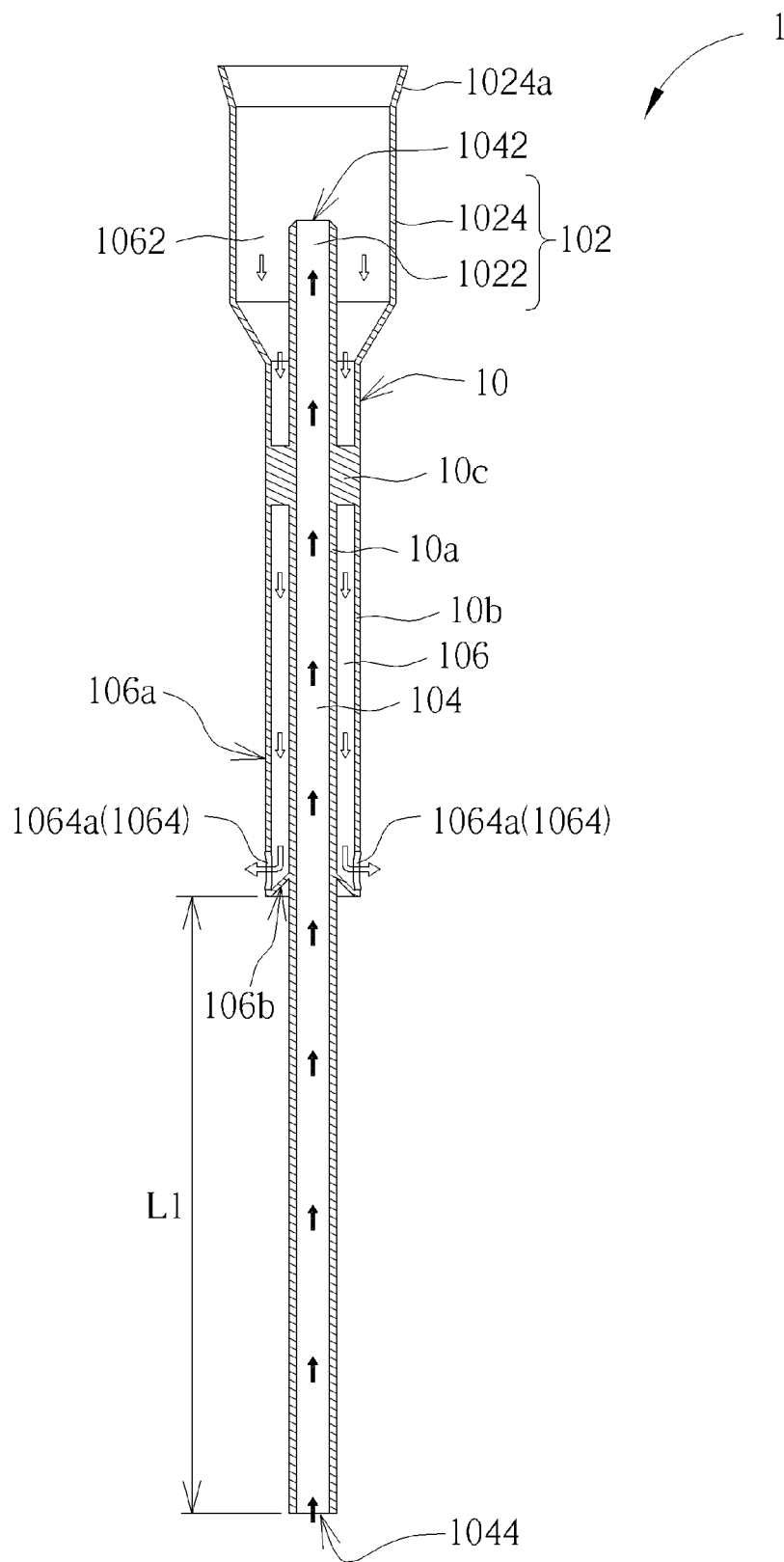


FIG. 3

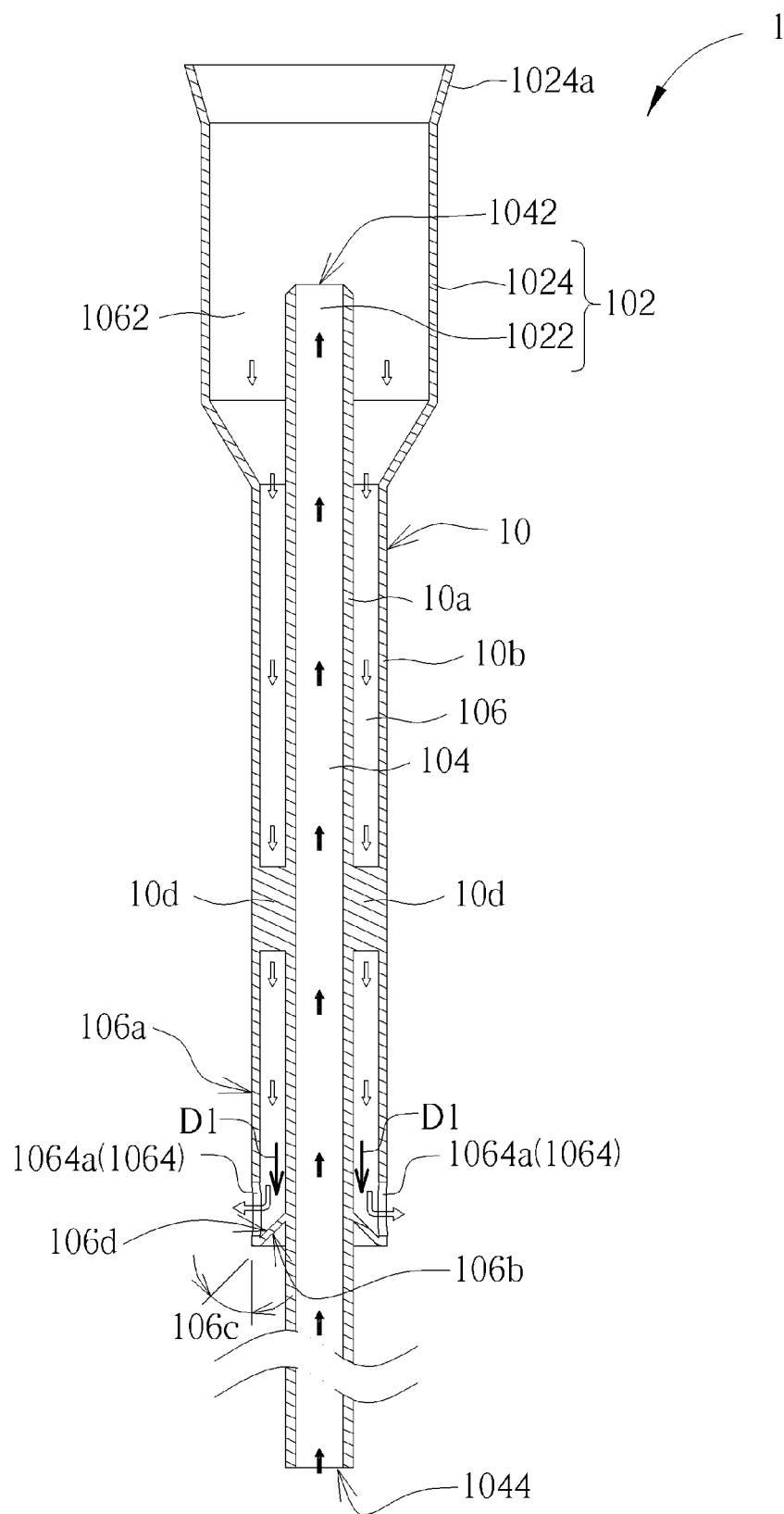


FIG. 4

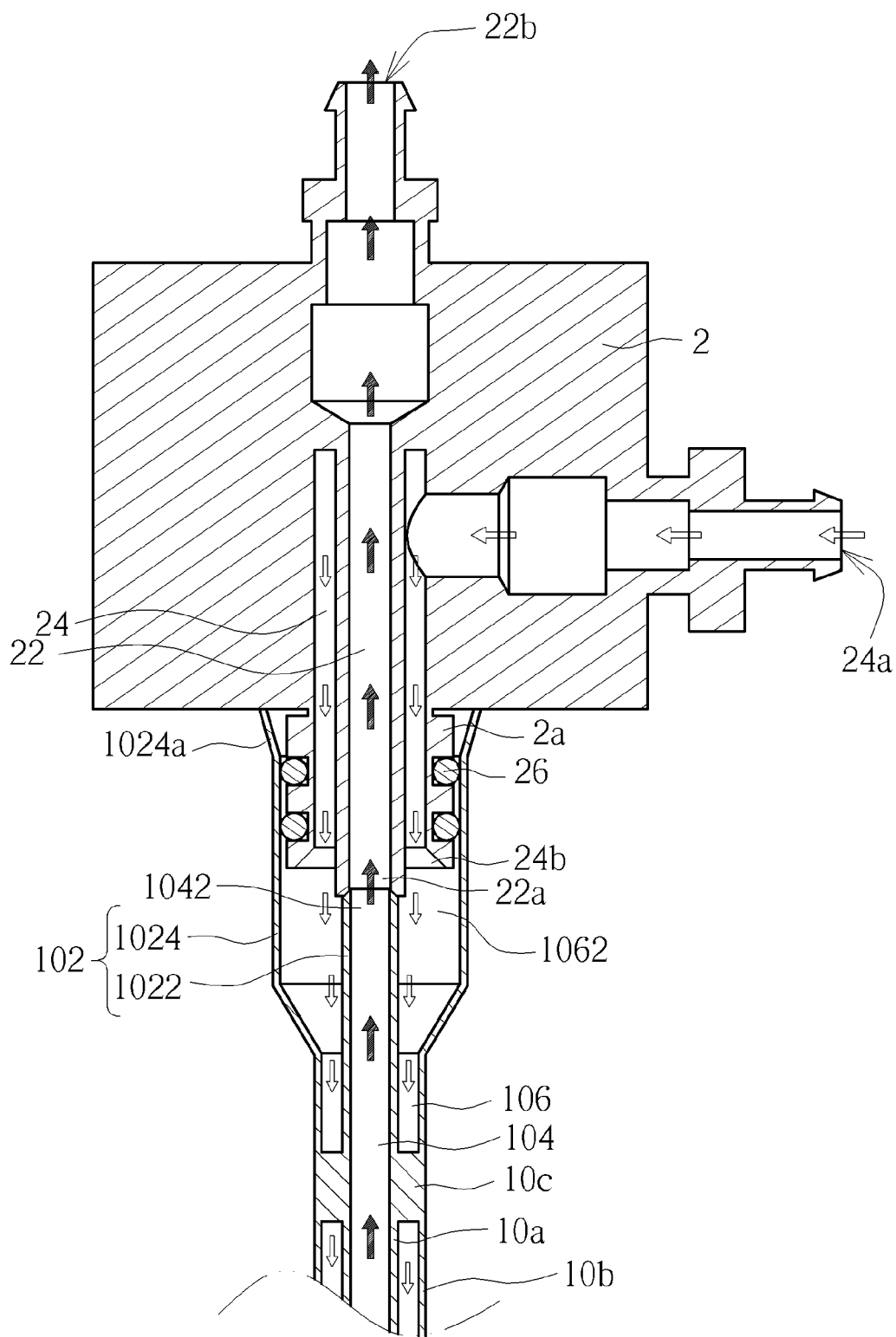


FIG. 5

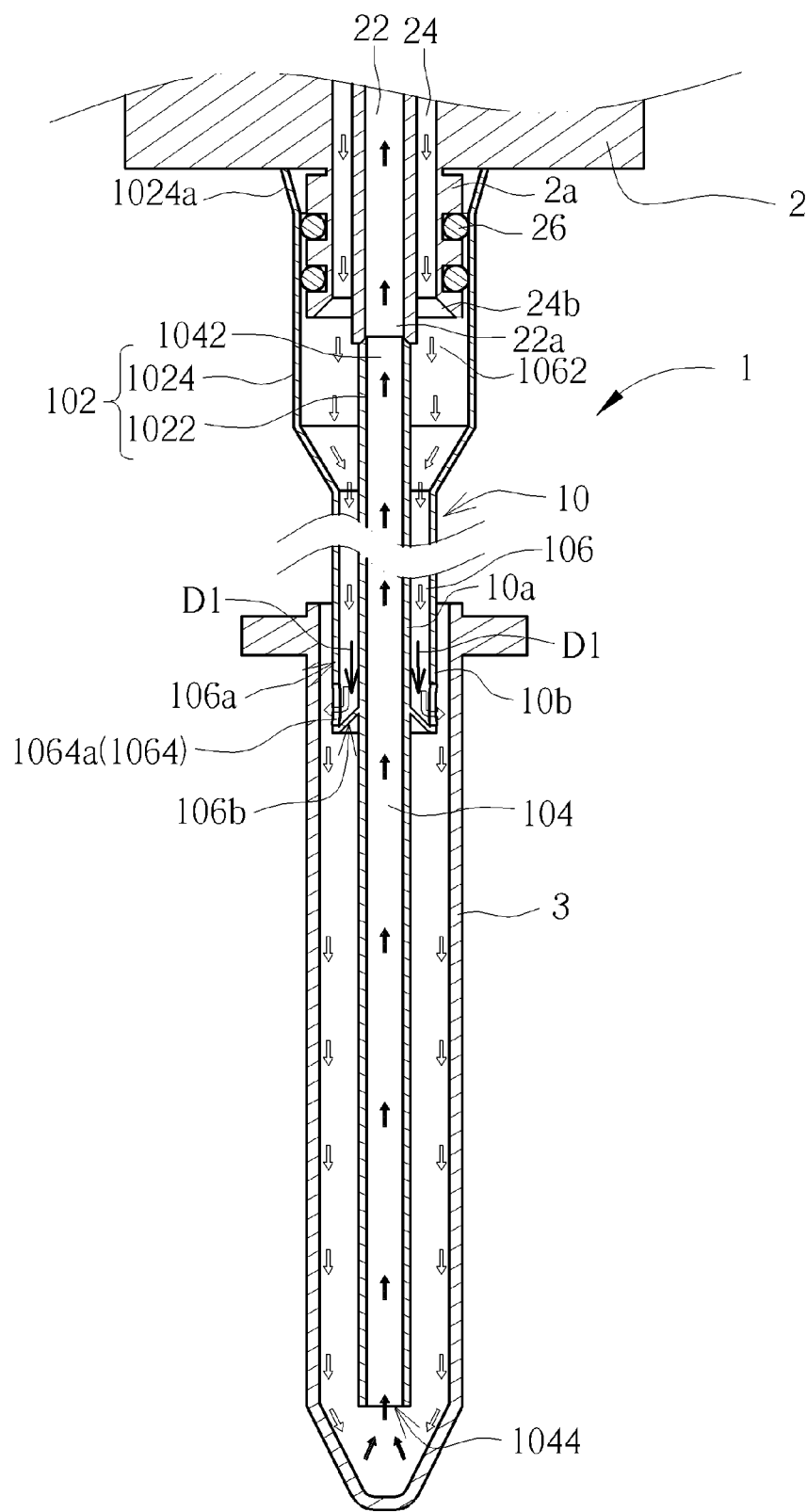


FIG. 6

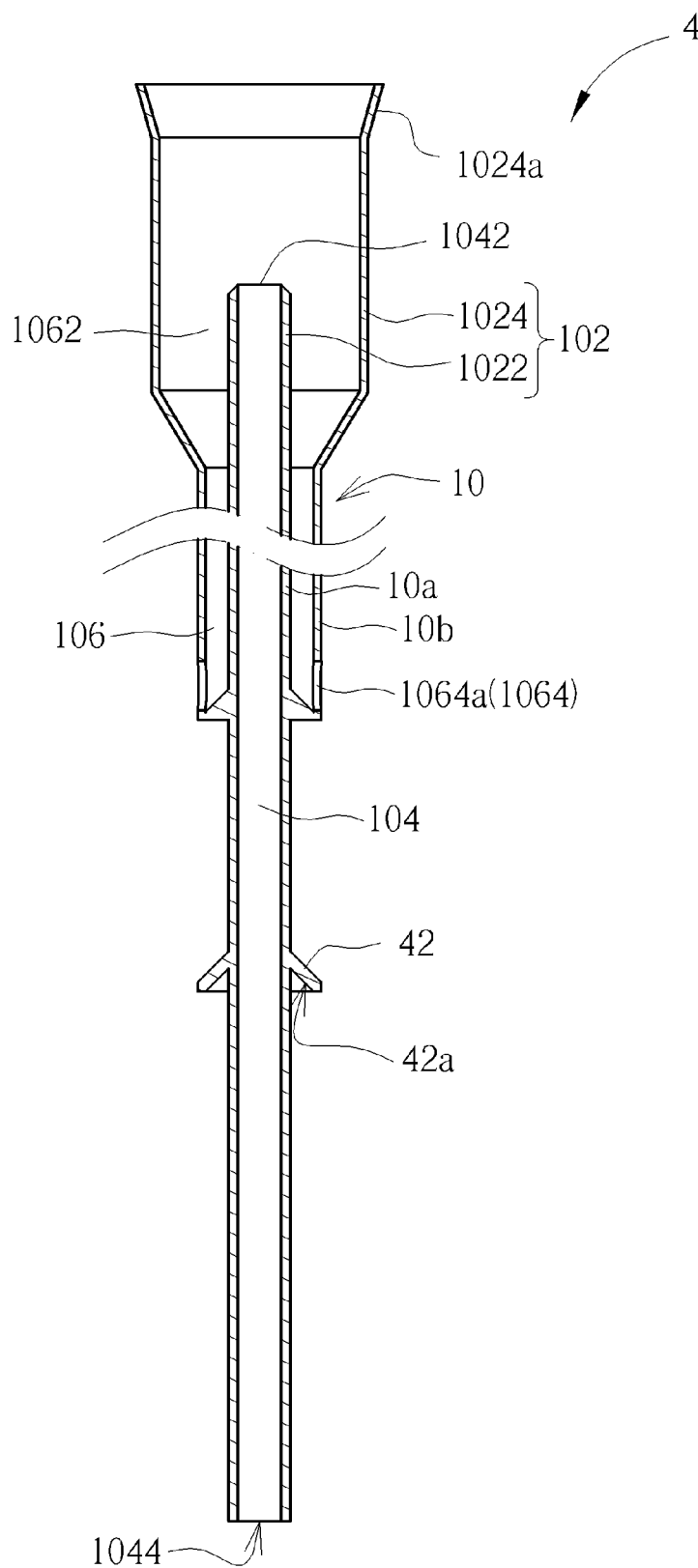


FIG. 7

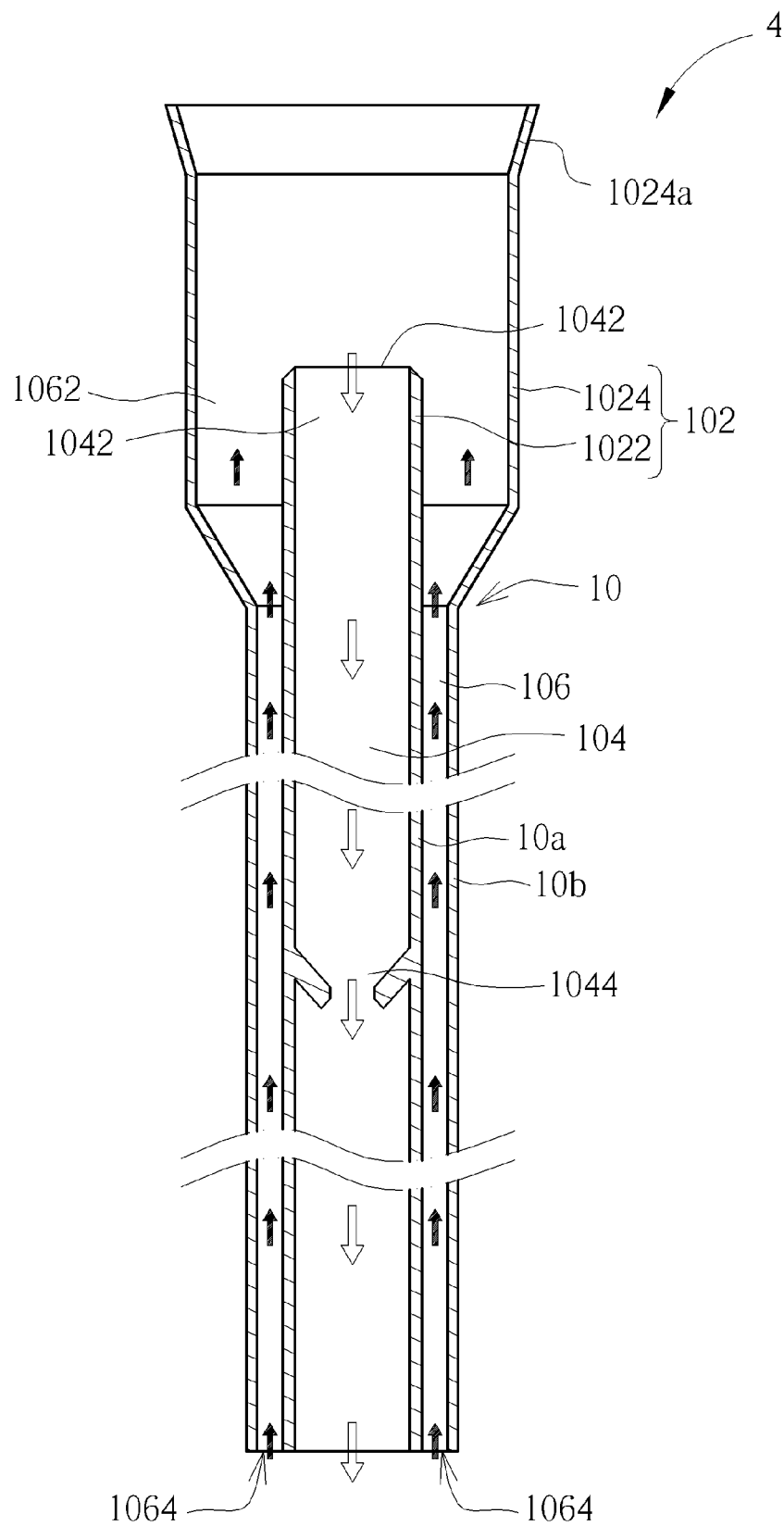


FIG. 8

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PIPETTE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a pipette, and especially relates to a pipette for washing a reaction tube.

2. Description of the Prior Art

Current automation of washing reaction tubes usually is performed through a work platform equipped with two sliding arms, each of which has an XY positioning mechanism and a Z positioning mechanism. Therein, one of the sliding arms is equipped with an adaptor for providing washing liquid, and the other one is equipped with an adaptor for drawing waste liquid. Each adaptor is sleeved with a common pipette for providing washing liquid or drawing waste liquid. In principle, injecting of the washing liquid and drawing of the waste liquid is performed separately for requirements for without pollutions on the reaction tubes. One injection of the washing liquid and one draw of the waste liquid are taken as a washing cycle. In general, the washing for the reaction tube needs three cycles. For meeting the requirement for without pollutions, at least the adaptor for drawing the waste liquid needs to use a new pipette every cycle so that no external pollutions get into the reaction tube that contains waste liquid to be drawn. Accordingly, the washing of the reaction tube includes a plurality of movements of the sliding arms and a plurality of operations of replacing pipettes, resulting in a longer washing time and a greater consumption of pipettes. Therefore, the current washing mechanism for reaction tubes can hardly reduce time cost and consumables cost.

SUMMARY OF THE INVENTION

An objective of the invention is to provide a pipette, which provides two paths through a single member. When the pipette is used in a washing process for a reaction tube, washing liquid and waste liquid can be injected and drawn respectively simultaneously, so that the movement time of the sliding arms and the replacement cost of the pipettes can be reduced.

A pipette according to the invention includes a pipe. The pipe includes a connection end portion, an inner flow passage, and an outer flow passage surrounding an inner flow passage. The inner flow passage has a first opening portion and a second opening portion opposite to the first opening portion. The outer flow passage has a third opening portion and a fourth opening portion opposite to the third opening portion. The first opening portion and the third opening portion are disposed at the connection end portion. The second opening portion and the fourth opening portion are disposed at an interval. Thereby, the pipette according to the invention can provide two flowing paths through a single member. Furthermore, the second opening portion and the fourth opening portion are separate, so that the two flowing paths will not interfere with each other. When used in a washing process for a reaction tube, the pipette is coupled through the connection end portion with an adaptor capable of providing washing liquid and drawing waste liquid. Then, a plurality of washing cycles can be performed by inserting the pipette into the reaction tube once. Compared with the prior art, for a washing process for one reaction tube (including three washing cycles), the pipette according to the invention just need one

Compared with the prior art, just one pipette according to the invention is needed for a washing process for a reaction tube (i.e. including three washing cycles), so the consumables

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cost is reduced. Besides, the time cost is also reduced due to no need to change the pipette during the washing process.

These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram illustrating a pipette of an embodiment according to the invention.

FIG. 2 is a top view of the pipette in FIG. 1.

FIG. 3 is a sectional view of the pipette in FIG. 2 along the line X-X.

FIG. 4 is a sectional view of the pipette in FIG. 2 along the line Y-Y.

FIG. 5 is a sectional view of the pipette in FIG. 1 applied to an adaptor.

FIG. 6 is a sectional view of the pipette in FIG. 1 inserted into a reaction tube.

FIG. 7 is a sectional view of a pipette of another embodiment according to the invention.

FIG. 8 is a sectional view of a pipette of another embodiment according to the invention.

DETAILED DESCRIPTION

Please refer to FIGS. 1-5. FIG. 1 is a schematic diagram illustrating a pipette 1 of an embodiment according to the invention. FIG. 2 is a top view of the pipette 1. FIG. 3 is a sectional view of the pipette 1 along the line X-X in FIG. 2. FIG. 4 is another sectional view of the pipette 1 along the line Y-Y in FIG. 2. FIG. 5 is a sectional view of the pipette 1 that is applied to an adaptor 2. The pipette 1 includes a pipe 10. The pipe 10 includes a connection end portion 102, an inner flow passage 104 and an outer flow passage 106 surrounding the inner flow passage 104. The inner flow passage 104 has a first opening portion 1042 and a second opening portion 1044 opposite to the first opening portion 1042. The outer flow passage 106 has a third opening portion 1062 and a fourth opening portion 1064 opposite to the third opening portion 1062. The first opening portion 1042 and the third opening portion 1062 are disposed at the connection end portion 102. The second opening portion 1044 and the fourth opening portion 1064 are disposed at an interval L1. The adaptor 2 has a waste liquid inlet 22a, a waste liquid outlet 22b connected to the waste liquid inlet 22a, a washing liquid inlet 24a, and a washing liquid outlet 24b connected to the washing liquid inlet 24a. When in use, the pipette 1 is coupled with the adaptor 2 through the connection end portion 102, so that the first opening portion 1042 of the inner flow passage 104 is coupled with the waste liquid inlet 22a and the third opening portion 1062 of the outer flow passage 106 is coupled with the washing liquid outlet 24b. Thereby, the inner flow passage 104 is connected to a waste liquid channel 22 inside the adaptor 2, and the outer flow passage 106 is connected to a washing liquid channel 24 inside the adaptor 2. Therein, the determination of the interval L1 depends on the use condition of an applied case (e.g. washing a reaction tube). In general, the interval L1 is shorter than the depth of the reaction tube. For example, for different application cases, the interval L1 can be within a range from 5 mm to 100 mm.

Furthermore, each of the inner flow passage 104 and the outer flow passage 106 forms a flowing path. In coordination with the flowing paths of the adaptor 2, the flowing path (indicated by solid arrows in the sectional views) of the inner

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flow passage **104** is located at the central portion of the pipe **10** while the flowing path (indicated by hollow arrows in the sectional views) of the outer flow passage **106** is located at the peripheral portion of the pipe **10**. By the staggered disposition of the second opening portion **1044** and the fourth opening portion **1064**, interference between the two flowing paths can be greatly reduced. Please also refer to FIG. 6. FIG. 6 is a sectional view of the pipette **1** inserted into a reaction tube **3**. When the pipette **1** is in use, the washing liquid passes through the washing liquid inlet **24a**, the washing liquid channel **24**, the washing liquid outlet **24b**, the third opening portion **1062**, the outer flow passage **106**, and the fourth opening portion **1064** to get in the reaction tube **3**; the waste liquid (including liquid originally existing inside the reaction tube **3** and the washing liquid having entered the reaction tube **3**) passes through the second opening portion **1044**, the inner flow passage **104**, the first opening portion **1042**, the waste liquid inlet **22a**, the waste liquid channel **22**, and the waste liquid outlet **22b** to be retrieved. In the embodiment, in coordination with the usage condition that the inner flow passage **104** connects with the waste liquid channel **22**, the second opening portion **1044** protrudes out of the fourth opening portion **1064**; i.e. in the view point of FIG. 6, the second opening portion **1044** is located relatively low. This configuration is conducive to an efficient retrieval of the waste liquid (including liquid originally existing inside the reaction tube **3** and the washing liquid having entered the reaction tube **3** from the fourth opening portion **1064**). However, the invention is not limited thereto.

Furthermore, in the embodiment, the pipe **10** is a coaxial structure, so the outer flow passage **106** shows a hollow cylinder. The outer flow passage **106** has an extending direction **D1** (indicated by a solid line segment with an arrow) at fourth opening portion **1064**. The fourth opening portion **1064** includes a plurality of holes **1064a** disposed outwards relative to the extending direction **D1**, so that the washing liquid substantially radially flows out the outer flow passage **106** from the holes **1064a** relative to the extending direction **D1** and flows down along the inner sidewall of the reaction tube **3**. Furthermore, in the embodiment, the holes **1064a** are disposed at the periphery at equal central angular intervals relative to the extending direction **D1**, which facilitates the washing liquid flowing in the reaction tube **3** uniformly and enhances the washing effect to the reaction tube **3**.

Furthermore, in the embodiment, the outer flow passage **106** has an outer sidewall surface **106a** and an outer end wall surface **106b** connected to the outer sidewall surface **106a**. The outer end wall surface **106b** is a concave conical surface. The holes **1064a** are located on the outer sidewall surface **106a** close to the outer end wall surface **106b**. By the design of the concave conical surface, if liquid spatters from the lower toward the fourth opening portion **1064**, the liquid can be blocked by the outer end wall surface **106b**; besides, by the effect of the geometric shape of the outer end wall surface **106b** (i.e. the outer end wall surface **106b** and the outer sidewall surface **106a** connecting with each other to form an acute angle **106c**), when the gravity of liquid adhering onto the outer end wall surface **106b** increases, the liquid will flows to the edge (i.e. where the outer sidewall surface **106a** and the outer end wall surface **106b**) of the outer end wall surface **106b** and drops, without spreading upward to the fourth opening portion **1064** to pollute the washing liquid. In practice, with a consideration to the adhesive force between the washing liquid and the outer sidewall surface **106a**, the holes **1064a** can be disposed a little away from the connection of the outer sidewall surface **106a** with the outer end wall surface **106b**, for further reducing the possibility that the liquid that

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has reached the edge of the outer end wall surface **106b** pollutes the washing liquid. In addition, in the embodiment, the outer flow passage **106** has an inner end wall surface **106d** opposite to the outer end wall surface **106b**. The inner end wall surface **106d** also shows a conical structure to provide a slanting surface relative to the extending direction **D1** for the washing liquid that passes through the fourth opening portion **1064**, so that after the liquid flowing out from the fourth opening portion **1064**, a force of the liquid hitting the inner sidewall of the reaction tube **3** can be reduced so that the washing liquid can flow downward along the inner sidewall of the reaction tube **3** more smoothly. However, the invention is not limited thereto; for example, the inner end wall surface **106d** is perpendicular to the extending direction **D1**.

It is added that in the embodiment, the outer end wall surface **106b** is concave conical so as to prevent spattering liquid from polluting the washing liquid; however, the invention is not limited thereto. In principle, the washing liquid flows out of the outer flow passage **106** from the holes **1064a**, so preventing the liquid adhering on the outer end wall surface **106b** from approaching the hole **1064a** can efficiently reduce the pollution in the washing liquid. Thereby, in practice, it is practicable to form an acute angle where portions of the outer end wall surface **106b** close to the holes **1064a** is connected with the outer sidewall surface **106a**, and the other portions of the outer end wall surface **106b** can be connected with the outer sidewall surface **106a** in a rectangular or obtuse angle.

It is added more that in the embodiment, the avoidance of pollution in the washing liquid induced by liquid spattering is achieved by the outer end wall surface **106b** of the outer flow passage **106**; however, the invention is not limited thereto. Please refer to FIG. 7, which is a sectional view of a pipette **4** of another embodiment according to the invention. The pipette **4** is substantially structurally equal to the pipette **1**, so the pipette **4** uses the same reference numbers as the pipette **1**. For other descriptions of the pipette **4**, please refer to the relevant descriptions of the components of the pipette **1** notated with the same reference numbers, which will not be repeated in addition. A difference between the pipette **4** and the pipette **1** is that the pipette **4** includes a block portion **42** which is disposed between the second opening portion **1044** and the fourth opening portion **1064** and also can prevent the waste liquid below spattering upwards from polluting the washing liquid from the fourth opening portion **1064**. Further, the block portion **42** has a concave conical surface **42a** surrounding the sidewall of the inner flow passage **104** toward the second opening portion **1044**. The concave conical surface **42a** has the same function as the concave conical outer end wall surface **106b**, which will not be repeated in addition. In another aspect, in the pipette **1**, the concave conical outer end wall surface **106b** is equal to the block portion **42** in logic.

Please refer to FIGS. 1 to 6. In the embodiment, the connection end portion **102** includes an inner ring wall **1022** and an outer ring wall **1024** surrounding the inner ring wall **1022**. The first opening portion **1042** is formed inside the inner ring wall **1022**. The third opening portion **1062** is formed between the inner ring wall **1022** and the outer ring wall **1024**. The adaptor **2** has a protruding connection port **2a**, of which the waste liquid inlet **22a** is located at the central portion and the washing liquid outlet **24b** is located at the peripheral portion. When the connection end portion **102** is coupled with the adaptor **2**, the outer ring wall **1024** tightly sleeves on the connection port **2a** of the adaptor **2** (for example with a O-ring **26** disposed therebetween), and the first opening portion **1042** tightly abuts against the waste liquid inlet **22a** (in practice, may be by an additional structure for coupling the first opening portion **1042** with the waste liquid inlet **22a** more tightly).

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Therein, the outer ring wall **1024** tightly sleeves on the connection port **2a** and the first opening portion **1042** tightly abuts against the waste liquid inlet **22a**, so the coupling of the third opening portion **1062** with the washing liquid outlet **24b**. Furthermore, in the embodiment, the outer ring wall **1024** has a bell mouth **1024a**, which is conducive to the insertion of the connection port **2a** into the connection end portion **102**.

In the above embodiments, the pipe **10** is realized by a coaxial structure, substantially consisting of an inner tube **10a** and an outer tube **10b** surrounding the inner tube **10a** (or the inner tube **10a** passing through the outer tube **10b**). A passage formed inside the inner tube **10a** serves as the inner flow passage **104**; a passage formed between the outer tube **10b** and the inner tube **10a** (i.e. bounded by the outer surface of the inner tube **10a** and the inner surface of the outer tube **10b**) serves as the outer flow passage **106**. As a whole, the inner flow passage **104** and the outer flow passage **106** extend in the same axis direction that is equal to the extending direction **D1** in the embodiment. Furthermore, for enhancing the structural strength of the outer tube **10b** and the inner tube **10a**, the pipe **10** includes a plurality of ribs **10c-10d**, connecting to the outer tube **10b** and the inner tube **10a** in different heights. The invention is, however, not limited thereto. For example, the outer tube **10b** and the inner tube **10a** are disposed to be eccentric, which also can form an inner flow passage substantially at the central portion and an outer flow passage surrounding the inner flow passage. For another example, a bundle of pipes is used so that in the sectional view thereof, the pipes at the central portion serve as an inner flow passage, and the pipes at the peripheral portion serve as an outer flow passage; therein, an end of the bundle forms a first opening portion of the inner flow passage and a third opening portion of the outer flow passage in a structural integration way or through an additional component, so that the end of the bundle can be coupled with the adaptor **2**. For another example, the pipe **10** can still be realized by a coaxial structure but not extends along a straight path.

In addition, the above embodiments are based on a condition that the second opening portion **1044** protrudes out the fourth opening portion **1064**, but the invention is not limited thereto. Please refer to FIG. **8**, which is a sectional view of a pipette **5** of an embodiment according to the invention. The pipette **5** is substantially equal to the pipette **1** in structural logic, so the pipette **5** uses the same reference numbers as the pipette **1**. For other descriptions of the components of the pipette **1** notated with the same reference numbers, which will not be repeated in addition. A difference between the pipette **5** and the pipette **1** is that in the pipette **5**, the fourth opening portion **1064** protrudes out the second opening portion **1044**. Therefore, in the embodiment, the inner flow passage **104** is used for the washing liquid, and the outer flow passage **106** is used for the waste liquid. In another aspect, when the pipette **5** is in use, the flowing paths of the inner flow passage **104** and the outer flow passage **106** are different to the flowing paths of the pipette **1**. Accordingly, the adaptor **2** (referring to FIG. **5**) is modified so that the channel **22** serves as a washing liquid channel, and the channel **24** serves as a waste liquid channel,

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which can be realized by washing the adaptor **2** and switching flowing paths (i.e. the flowing paths connected to the adaptor **2**) for example. In this case, the structural connection of the connection end portion **102** of the pipette **5** with the connection port **2a** of the adaptor **2** still can be the same as that of the pipette **1** with the adaptor **2**. In practice, it is acceptable to modify the structure design of the connection end portion **102** of the pipette **5**, so that the inner flow passage **104** of the pipette **5** still can connect with the channel **22** and the outer flow passage **106** still can connect with the channel **24**, which can avoid an operation of re-setting the channels of the adaptor **2**.

Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. A pipette, comprising:

a pipe, comprising a connection end portion, an inner flow passage, and an outer flow passage surrounding an inner flow passage, the inner flow passage having a first opening portion and a second opening portion opposite to the first opening portion, the outer flow passage having a third opening portion and a fourth opening portion opposite to the third opening portion, the first opening portion and the third opening portion being disposed at the connection end portion, the second opening portion and the fourth opening portion being disposed at an interval, the second opening portion protruding from the fourth opening portion, the outer flow passage having an extending direction at the fourth opening portion, the fourth opening portion comprising a plurality of holes disposed outwards relative to the extending direction, the outer flow passage having an outer sidewall surface and an outer end wall surface, the outer end wall surface and the outer sidewall surface connecting to form an acute angle.

2. The pipette of claim 1, wherein the outer end wall surface is a concave conical surface, and the plurality of holes are located on the outer sidewall surface close to the outer end wall surface.

3. The pipette of claim 1, further comprising a block portion disposed between the second opening portion and the fourth opening portion.

4. The pipette of claim 3, wherein the block portion has a concave conical surface surrounding the inner flow passage and facing the second opening portion.

5. The pipette of claim 1, wherein the connection end portion comprises an inner ring wall and an outer ring wall surrounding the inner ring wall, the first opening portion is formed inside the inner ring wall, and the third opening portion is formed between the inner ring wall and the outer ring wall.

6. The pipette of claim 1, wherein the pipe is a coaxial structure.

7. The pipette of claim 1, wherein the interval is within a range from 5 mm to 100 mm.

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